newtechnology

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A DTI eye on overseas R & D

THE UK has Scientific Counsellors in seven posts around the world covering 12 of the more advanced countries. The Department of Trade and Industry is the UK reference point for Scientific Counsellors, who regularly file reports and newsletters on the interplay between government, industry, science and technology in the countries they cover. These reports and newsletters are made available to UK industry and research institutions through DTI's Overseas Technical Information Unit.

The countries covered are: Austria, France, Switzerland, Canada, Germany, Sweden, Denmark, Japan, USA, Finland, Norway, USSR.

Science abroad and UKSM reports

Each report in these series deals with a separate field of research and development, often in the form of a wide-ranging 'state-of-the-art' review on a particular topic. UKSM reports are produced by the United Kingdom Scientific Mission in Washington. Recent issues have covered such subjects as corrosion research in Scandinavia, government support for science and technology in Japan, advances in Gunn and Impati diodes, and the USA view on the effects of lead in petrol.

Bonn, Ottawa, Tokyo and Washington Newsletters

These newsletters group together shorter items on science and technology, and include reports of new discoveries and changes in legislation affecting science-based industry. Their subject coverage extends from such fields as biology and behavioral science to science and industrial policy. In the last year subjects have included submarine bulldozers, environmental programmes, international computer technology links, and satellites.

Technology and the Environment

This new quarterly draws together news, comment and opinion from all the Scientific Counsellors on the interaction of technology and the environment. Each issue focuses on a single subject—for instance, noise abatement and control. In this latter case the issue contained state-of-the-art reviews of the activities within various countries covering existing and proposed legislation, together with noise from aircraft, traffic, construction and factories, thus giving a comparative picture of overseas practice and experience.

Environmental Bulletin, Laser Newsletter and Transportation Bulletin

These 'specialist' newsletters and bulletins are intended for those with a close interest in these fields. At present, they contain mainly news items from North America. Laser Newsletter, the longest established of the three, had notched up 74 issues by the end of 1971.

Annual indexes

Complete listings of the reports, newsletters and bulletins produced by the Scientific Counsellors each year are available from OTIU.

Overseas Newsletter

The Overseas Technical Information Unit prepares a bi-monthly bulletin under this title containing summaries of all new reports in the Science Abroad and UKSM report series. This bulletin provides a convenient way for readers to keep in touch with reports of current interest. Additionally, Overseas Newsletter contains details of forthcoming new items and series together with news of other services available from the Unit.

Other services

As part of its services to the UK scientific and technological communities, the OTIU also provides access to other foreign information. Prominent among these other information sources is the complete set of *VDI Richtlinien* maintained by the Unit. The *Richtlinien*, whilst not having the authority of standards, are akin to Codes of Practice, and are widely specified in designs and contracts in Europe. The *Richtlinien* are published in German, but to assist UK users the Unit publishes a comprehensive English-language Index.

OECD publications

The Organisation for Economic Co-operation and Development publishes many documents and reports of interest to UK science and industry. Many of these are available on sale through HMSO's Government Bookshops, but some are available only from OECD. The OTIU is able to help inquirers about the latter with information about titles, coverage and availability.

Scientific Representatives in London and overseas

The OTIU regularly issues lists giving details of UK Scientific Representatives Abroad and Overseas Scientific Representatives in London.

More information: The reports and services described are available only to UK industry and UK research organisations. Inquiries should preferably be made under organisations' letterheads to:

Overseas Technical Information Unit A2, Department of Trade and Industry, Abell House, John Islip Street, London SW1P 4LN. Telephone inquiries: 01-834 4422 (Counsellors' Reports Ext. 302; *VDI Richtlinien* Ext. 161; OECD & lists Ext. 601).

Terotechnology: a Way to Reduce Costs

by F. A. Townson, RCA Ltd.

Maintenance engineering in the manufacturing industries alone is costing the UK some £1,100 million a year (1968 prices), and, if only industry could be persuaded to take action on a proper appreciation of all the factors involved in maintenance, some £200-£250 million of this sum could be saved on direct costs, and a further £200-£300 million on indirect costs. This is the nub of the findings of the Working Party set up by the former Ministry of Technology to look into the status of maintenance engineering in the UK. The Working Party's survey (its report was published by HMSO in May 1970) was followed by discussions with leading industrialists, educationists and engineers. Recognition that the maintainability problem was far more complex than implied by the term 'maintenance engineering' brought into being the concept of terotechnology, which can be defined as the technology of installation, commissioning, maintenance, replacement and removal of plant, machinery and equipment, of feed-back to design and operation thereof, and of related subjects and practices. A Committee on Terotechnology was subsequently formed to advise the Secretary of State for Trade and Industry on matters concerning the new discipline, and to examine and recommend to the Minister ways of introducing good terotechnological practices to industry.

Writing about the aims of the Committee, its Chairman, Sir Leonard Atkinson, suggested that a lack of understanding of the true meaning of maintenance was prevalent among management in this country. 'In many cases', he wrote, 'top management does not appreciate the need for good preventive maintenance, or, if it does, tends to delegate responsibility to too low a level. It would not be unfair to say that executives look upon maintenance expenditure as some form of tax on their activities, but whereas they cheerfully employ an accountant to ensure that they do not overpay tax, seldom do they employ someone who is equally as competent at minimising maintenance costs. . . . As for the maintenance manager, his lot is not a happy one: he starts at the bottom; his chances of being qualified are meagre; and he gets poor pay and little recognition'. Maintenance management is hence a facet of terotechnology which would appear to bear looking at. In recent years one UK firm—RCA Ltd.—has had to do just that, and in depth, as a necessary preliminary to achieving the highest degree of system operability at the lowest possible cost in various large government contracts with which it is concerned. The contracts include the Suffolk Radio Research Project, the Christchurch satellite communications centre, an ESRO centre in Belgium and the Fylingdales link in the Ballistic Missile Early Warning System, and all demand considerable expertise in both the electrical- and mechanical-engineering fields. At Fylingdales, for example, the firm is responsible for maintaining some £40 million worth of equipment, utilities and buildings. For each of its contracts the company has developed a maintenance-management system which has considerably increased the operability/operational-cost ratio; and RCA is convinced that what has been learned from participation in such large-scale government schemes can be successfully applied to increase profitability in the industrial sector. Whether the organisation be Fylingdales or a small engineering shop, so RCA argues, the concept is the same: the level of operability would simply be lower in the case of the engineering shop, and the cost of installing the system proportionately less.

In this article F. A. Townson, a member of RCA's Service Division, Sunbury-on-Thames, Middlesex, outlines the firm's approach to some of the components of terotechnology.

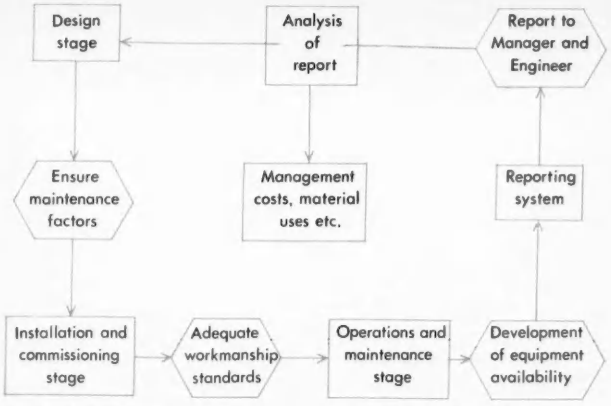
The Maintenance-Management System

THE approach will depend on the stage of development at which the system is to be introduced. The earlier planning starts the better. The design stage is that at which maintenance management is usually least considered, but at which decisions have the greatest impact on subsequent maintenance management; ease of maintenance should hence be built into equipment design. A high standard of workmanship at the installation stage will also facilitate subsequent repair or overhaul, and a detailed record of equipment performance after installation is indispensible to any subsequent reassessment of equipment/plant design. The ultimate criterion is minimum cost for a specified level of operability, but every project should also have goals for reliability (entailing a design factor for mean time between plant failures) and maintainability (requiring a design factor for mean time to repair). The last two goals will, of course, be influenced by choice of plant sub-items. When all three goals are achieved, it will be known how often the plant will fail, how long it will be operable, the amounts of spares to be held, and whether profitability requirements are being met.

Installation and Commissioning

To ensure a high standard of workmanship, quality-assurance standards should be set for the installation stage. In assessing the optimum cost for a given level of operability, such factors as capital-equipment costs, operating costs and maintenance costs must be included, and the required life of the plant, or at least the required production life of a specific item of equipment, has also to be taken into account.

The commissioning stage is every bit as important as the installation stage, since it is the first chance to assess the reliability of the equipment in operation. If results are unsatisfactory, the alternatives are to provide stand-by equipment for the most sensitive areas or to modify the maintenance system, either by increasing the spare holdings to cover corrective maintenance, or by increasing the frequency of preventive maintenance. These approaches all reduce profitability, and an optimum compromise has therefore to be reached. It is essential to use a Reliability and Data Reports Group (possibly comprising just one man), and to establish a system of failure reporting ensuring that accurate information is transferred to the Group from the shop floor. Such information will be vital should maintenance problems occur at a later date, although the failure-reporting system must take into account the fact that there will usually be more failures in the commissioning period than in a similar period during operation and maintenance. The amount of data to be extracted depends on the time



A typical 'closed-loop' flow chart for feedback of information

and effort applied: and, of course, the more data provided, the greater will be the value in maintenance management.

Operation and Maintenance

The transition from the installation phase to operation and maintenance will require a change of emphasis. The following actions will need to be put into effect in setting up a maintenance system at the operating and maintenance stage:

Establishment of equipment-availability goals.
Establishment of reliability and maintainability goals.
Development of preventive-maintenance routines.
Creation of co-ordination and schedule office (Central Maintenance Office).
Assessment of spares requirements.
Assessment of man-power requirements.
Motivation of the work force.

Reporting of Maintenance Actions

Objectives: A planned preventive-maintenance system will be designed to minimise costs in relation to given operability goals, thus maximising profits. Resources, including capital equipment, man-power and other facilities, must be used as efficiently as possible. Hence maintenance management has to know how resources are employed and how their utilisation may be improved. The question of whether to provide stand-by equipment, for example, may be answered by establishing the threshold at which the cost of a stand-by facility will exceed the cost of production stoppages.

Judicious use of a reporting system will establish the correct quantities of spares to be held and their appropriate replacement rates, and can contribute to determining whether labour utilisation may be improved. A reporting system will provide an overall picture of the requirements of the maintenance operation, enabling maintenance to be carried out as an integrated part of the business, though in this respect good communication between management and operator is essential.

Documentation: The system must be clearly understood by all personnel, from the managing director down to the maintenance technician. A series of preventive maintenance instructions (PMI's) should be developed, stipulating the frequency of the action required (eg, daily, weekly, monthly), and a maintenance data collection form (MDCF) should also be designed: the 'PMI' conveys information to the technicians, and the 'MDCF' gives information to management. Finally, a maintenance management instruction (MMI) should be introduced to instruct the technicians in the use of PMI's and MDCF's. The MMI gives instruction on how to complete the MDCF, and also contains the codes which will identify maintenance actions and their related circumstances.

Function and Control: The most significant function of the system is to identify developing trends and potential bottlenecks, so enabling management to plan forward and initiate corrective action before operation is adversely affected. A 'closed-loop' system for the feedback of information (Fig. 1 is a typical flow chart) is essential for this purpose. Correct use of the information fed back by this system will minimise unscheduled downtime for plant, and maximise utilisation of company assets and maintenance equipment. The reporting system will enable the period between preventive maintenance (PM) and the time allowable for maintenance to be determined, and so facilitate scheduling, and it will show where excessive PM is in operation, or when equipment is no longer carrying out its work efficiently. Control of the reporting system should be exercised by a Central Maintenance Office (CMO), responsible for planning, scheduling, co-ordination and control of all maintenance requirements. The CMO will be the focal point where all information is assembled, collated and assessed to ascertain what actions are necessary to maintenance management.

Central Maintenance Office

The CMO has the following tasks:

Planning: One task is to formulate and publish timely maintenance plans (and subsequent revisions) programming all known or predictable maintenance requirements at time intervals (daily, weekly, monthly or longer) appropriate to the operation. Plans should be submitted to the Maintenance/Production Managers for agreement prior to implementation.

The maintenance plan should be divided into two parts, covering (1) all maintenance actions (identified by preventive maintenance instructions) when the equipment is in service, and (2) all the 'out-of-service' requirements, the times for which will also be identified by PMI's. Other tasks which are not classed as maintenance actions will be entered in the plan as repairs or modifications, all actions incurring downtime or partial downtime being regarded as downtime actions.

Scheduling: A timely maintenance schedule will inform all maintenance personnel of the action required and the completion date. Maintenance personnel and facilities can be efficiently used only by adhering to carefully prepared maintenance plans and by proper scheduling of activities.

Workload control: To ensure that all maintenance is adequately scheduled and controlled, a work-load control function should be established to:

Direct the maintenance for each work centre by the preparation of a maintenance schedule/plan.
Assign priorities to the maintenance schedule/plan.
Establish a job control register.
Initiate MDC forms for all scheduled maintenance.
Assign a job control number to the MDC forms.
Monitor outstanding jobs.
Maintain a current master file of PMI's.
Conduct scheduling meetings as required.
Co-ordinate all requests for deviations from the maintenance plan.

Computer-Controlled Maintenance

If the maintenance system is large and complex, use of a computer is justified. In this case reliability reports, modification history, and data on parts consumption and man-hours expenditure will all be stored on a master history tape (MHT) derived from punched-card data derived from maintenance forms. The MHT information comprises the bulk of the data extracted, but more sophisticated analyses are also available. For example, details of every failure of a specific component can be obtained from the MHT by use of a simple data format. The analysis will include the type of failure, how the defect was rectified, the time taken and alternative part numbers where available. From such information the life expectancy of a part or assembly can be forecast, so allowing replacement before failure. The MHT can also be used to locate and check the progress of assemblies being repaired in the workshops.

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Computers in the design office

A SERIES of courses on *Computers in the Design Office* have been organised by Software Licencees Ltd., in collaboration with the Birniehill Institute of the National Engineering Laboratory, East Kilbride. The courses are for engineers already employed in design offices and are organised as a series of freestanding modules. Delegates to the second and third modules will have to attend earlier modules or satisfy Software Licencees that they have reached a satisfactory standard.

The following subjects are introduced and developed in the courses: **Organisation**—(a) The impact of change, the need for change, individual and group attitudes, overcoming resistance to change; (b) Systems analysis, operational research, information theory; (c) Project control, economics of computer usage. **Use of Computer Programs**—(a) Present day methods of using computers, the meaning of terms, the role of the mini computer and terminals; (b) Acceptable documentation standards, verification and certification of computer programs, professional responsibility, liability; (c) Input and output forms, operator instructions, diagnostics, running of integrated suites, checking of intermediate results. **Applications**—(a) Stress analysis, computer-aided design, graphics; (b) The use of frame analysis and finite element programs; (c) Use of terminals, mini computers, remote batch applications; (d) Bureau support, turnround times, use of plotters, line printers on line and off line; (e) Data banking of design information, information storage and retrieval. Further details from: Conference Management/MRL, Royal Buildings, 2 Mosley Street, Manchester M2 3AN (tel: 061-228 1601).

The Birniehill Institute is also organising the following courses: *Workshop analysis and scheduling program* (March 21-22), *Analysis, design and manufacture of heat pipes* (April 11-13) and *Group technology practice* (May 3). Further details from the Institute, NEL, East Kilbride, Glasgow (Tel. East Kilbride 20222, ext. 570).

Surface and underwater technology

LATEST developments in surface and underwater technology in 12 countries will be discussed at Oceanology International 72, a four-day conference at Brighton from March 21 to 24. It will be inaugurated by Mr. David Price, Parliamentary Under-Secretary of State for Aerospace, who also has special responsibility for research.

At the accompanying Oceanology International 72 Exhibition, which opens on March 20, some of the oceanology research and development achievements of the DTI will be among the themes of a Government display. The Department's Research Division will demonstrate the use of hovercraft for survey work and feature exhibits illustrating the work of the interdepartmental Committee on Marine Technology and its technical arm, the Marine Technology Support Unit. These exhibits will cover such projects as the technology of maritime safety, high-resolution underwater TV, the use of submersibles for underwater search and recovery, sea-bed sonar systems for fishing research and sea-bed charting, an extended-range underwater viewing device, and a new type of off-shore platform. Britain's progress report on achievements in surface and underwater technology will be presented at the conference on the morning of March 22 by Mr. P. F. G. Twinn, of the Committee on Marine Technology.

New laser anemometer

AN advanced laser-anemometry system, developed as a result of three years' close collaboration between DISA (Harrow) and the Atomic Energy Research Establishment, uses an optical Doppler-shift technique to permit fluid velocities —particularly turbulent velocities—to be measured and analysed without disturbing the flow. Harwell has designed and developed a prototype instrument, and the system is to be marketed by DISA. Tests conducted on prototypes by universities and industry in the UK and abroad have confirmed that accuracy in a linear output is high over a wide range of velocities (from cm/sec to 100 m/sec). The response time for continuous measurement of a rapidly varying velocity is very short, and the spatial resolution of the measurement is about 0.1 mm.

Harwell is continuing its development work on laser anemometry with the aim of extending its sensitivity to supersonic velocities and its range for ground-based measurements of atmosphere wind to heights of hundreds of metres. More information: Equipment—DISA, 116 College Road, Harrow, Middlesex. (Tel. Harrow 9263); Technical—Mr. P. J. Bourke, AERE, Harwell, Didcot, Berks. (Tel. Abingdon 4141, ext. 4410/3052).

PERA completes superplasticity survey

A SURVEY of the current development and economics of the superplasticity of metals has recently been completed by the Production Engineering Research Station. Superplasticity is a property peculiar to certain metals and alloys whereby they can be manipulated like plastics after heating to comparatively low temperatures. During the investigation PERA co-operated with companies and associations who were involved in development and production of superplastic materials and in the manufacture of components from these materials. The survey confirms that the present development and research in the UK is directed to methods of producing the material rather than component application. However, a small number of batch production applications have been successful.

The main points covered by the survey are the structure of superplastic alloys and suitable techniques for producing components from sheet or bar. A review of currently available materials is also included together with an assessment of cost savings which could accrue from the use of these materials. The next stage in the PERA programme will be a series of studies to evaluate superplastic materials for a wide range of industrial applications. PERA will discuss the feasibility of using superplastic materials with companies interested in the possible economic benefits. More information: PERA, Melton Mowbray, Leics. (Tel. Melton Mowbray 4133.)

Educational technology

A NEW central organisation for educational technology, established and financed by the Government, is proposed in a report published by the Department of Education and Science. It would replace the existing National Council for Educational Technology. These proposals are among recommendations of a working party set up by the Secretary of State for Education and Science, Mrs. Margaret Thatcher, in January 1971, to consider new central arrangements for promoting educational technology in the United Kingdom.

The working party reviewed existing provision and has suggested an organisational framework to meet the needs of teachers, instructors and students. It suggests that all interested bodies might work together to establish a full range of services. Its governing body would include representatives of education authorities, universities, teachers' associations, industrial training bodies and some of the main organisations providing services in the field of educational technology. The function of the proposed central organisation would be to support and stimulate innovation and development. It would also help education authorities and other responsible bodies to identify needs and to make arrangements for meeting those needs.

The report points out that the proposed central organisation's relationship with the various sectors of education and vocational and industrial training would be advisory. It suggests that the work of the central body would become fully effective only when those sectors set up their own consultative organisations to keep their own needs under review. Implementation of the working party's recommendations would require decisions by the Government and by education authorities and other organisations. The Secretary of State is inviting interested parties to consider the report and to offer comments by the middle of April. *Central Arrangements for Promoting Educational Technology in the United Kingdom* is 37½p from HMSO.

HOW TO SUBSCRIBE TO *NEW TECHNOLOGY*

There are two ways in which readers can arrange to receive the *New Technology* supplement regularly: *Either* by taking out a full annual subscription to *Trade and Industry* at £7.60 (including postage).

Or by subscribing to the 12 issues of *Trade and Industry* per year which contain *New Technology* at £1.75 (including postage).

Subscriptions to: HMSO, PO Box 569, London SE1.

Reprints of *New Technology* are available (at 5p per copy) from: New Technology, Room 437, Department of Trade and Industry, 1 Victoria Street, London SW1H 0ET.

More information: Where possible, items in *New Technology* indicate the best sources of further information. Readers are advised also to seek information on matters relating to *New Technology* from the following DTI regional offices: Edinburgh 031-225 1822; Cardiff 62131; Newcastle upon Tyne 27575; Manchester, 061-832 9111; Leeds 38232; Nottingham 46121; Birmingham, 021-643 8221; Bristol 21071; London and South East, 01-684 9781; Eastern, 01-828 4355. In Northern Ireland, information is given by the Dept. of Industrial and Forensic Science, Belfast 21722.

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